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The Financial Deregulation and The Production Technology of Philippine Domestic Commercial Banks: Estimation of Cost Functions in the Period of 1988-1996*

Hidenobu Okuda
Graduate School of Economics
Hitotsubashi University

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1. Introduction

The Philippine government set out to implement financial liberalization policies in the early 1980s. During the second half of the 1980s, financial liberalization measures were temporarily halted in order to rehabilitate domestic financial institutions. The Philippine economy was severely damaged by the national political and economic turmoil during this period. It was not until the beginning of the 1990s did the Philippine economy finally embark on its path to recovery, and gradually saw the re-establishment of financial liberalization policies. As shown in Table-1, these financial reform policies were ultimately aimed at realizing efficient allocation of resources through sound-market competition based on self-responsibility of financial institutions.

The financial reform policy is premised on efficient financial institutions that are able to provide suitable financial services with optimum technology at minimum cost. The Philippine financial reform policies intended to give domestic banks strong incentives to increase the size of their business operations and to encourage the banks to diversify their financial services. In turn, the Philippine government hopes that the commercial banks will be able to realize "economies of scale" and "economies of scope," both of which are recognized to be characteristics of an efficient banking industry. At the same time, the reform policies also hoped to see the introduction of new technology through the expansion of modernization investments by the Philippine banks[1].

A number of studies have been conducted on the subject of recent financial reform policies in the Philippines[2]. Many of these studies suggest that the efficient operation of financial institutions based on market competition, is the key to financial reform success. However, there appears to be a lack of formal econometric analysis that sheds light on the recent business operations of Philippine financial institutions[3].

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[1] See Lamberte and Lalantto (1995) and Paderanga (1995) for more details.

[2] Among the recent major studies, Lamberte (1995), Lamberte and Lalanto (1995), and Paderanga (1995) overviewed the process of financial reforms in relation with financial development in the Philippines. Ravalo (1993), Gochoko (1989), and Tan (1991) investigated the recent financial market structure.

[3] This is common for other ASEAN countries. Okuda and Mieno (1997) is a recent study on

Table 1 Chronology of Major Financial Reforms: 1989-1995

Further Deregulation of interest rates

1994	Revision of the Central Bank rediscount system. Elimination of prohibition of interest payment to demand deposits.

Deregulation of operational regulations and competition-promoting policy

1989	Measures to promote competition among banks. Abolition of regulation of opening new branches in preferentially treated agricultural area. Unification of legal reserve ratios
1990	Abolition of moratorium of new entry by domestic banks. Raising the minimum paid-in capital of savings banks. Approved off-site ATMs.
1991	Liberalization of regulation on opening bank branches. Approval of opening branches across the country was given to agricultural bank. Measure to promote bank mergers/consolidation. The Central Bank's approval became unnecessary for installing ATM in areas where branch does not exist.
1992	Measure to promote the opening of branches.
1993	Deregulation of ATM installation criteria
1994	Liberalization of market entry by foreign banks. Reduction of required equivalent capital for opening branches for savings banks

Deregulation of Foreign Exchange Transaction

1992	Raised the ceiling on the ratio of foreign exchange holding to receipts from exports to 40%. Abolition of foreign exchange regulation as a principle
1993	Further deregulation measures of foreign exchange transactions. Suspension of debt-equity swap
1994	Liberalization of foreign bank entry

Maintenance of credit order and relief of financial institutions

1990	Raised minimum paid-in capital of savings banks.
1991	Raised minimum paid-in capital of enlarged commercial banks and commercial banks. Measure to promote bank mergers and consolidation
1992	Rural Bank Act of 1992.
1993	Capital ratio, liquidity and profitability and sound management became criteria for approving the opening of bank branches. The New Central Bank Act was enacted. Legal reserves were introduced to common trust funds.
1994	Revision of minimum paid-in capital for savings banks.
1995	Increase in the minimum paid-in capital for banks. Thrift Bank Act of 1995

(Source) Paderanga (1995) and Bangko Sentral ng Pilipinas, *Annual Report,* various issues.

To the knowledge of the author, since Lamberte (1982)[4], there has been no rigorous investigation concerning the production technology of Philippine financial institutions after the start of financial liberalization policies in the 1980s. A large void needs to be filled regarding the study of recent production technology in the Philippine banking industry.

One commonly used method of examining the production technology of financial institutions is through the estimation of the banks' cost functions. For the study of financial institutions in the industrial countries, there has been a series of literature on the cost function of banks starting with Alhadeff (1954), through studies by Gilligan and Smirlock (1984) and Gilligan et al (1984), up to the recent research by Baltagi et al (1995). In these studies, the estimation methodology of production technology has been well established, and the "economies of scale and scope" progress is commonly observed in the competitive banking industry. Technological progress in the banking industry has also been well estimated in the industrialized countries.

Using the standardized estimation methodology as mentioned, this paper will discuss the recent production technologies of the Philippine domestic commercial banks. Domestic banks in the Philippines are recognized to be the core of the country's financial system. The major attempt of this study is to analyze the recent operational behavior and technical progress among Philippine domestic banks with the help of microeconomic financial data on individual commercial banks. Such an analysis is essential for understanding the characteristics of the Philippine banking industry under financial reforms, which is the supplement to the findings in the macroeconomic studies on the Philippine financial reform policies.

The timeframe of this study spans from 1988 to 1995. The year 1988 marks the year when the deregulation policies were re-instated. It is also during this period that the Philippine banking industry experienced steady growth under restored macroeconomic stability.

Our estimation of bank cost functions consists of two parts. One, is the cross-

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the production technology of Thai commercial banks.

[4] Lamberte (1982) estimated the cost functions of commercial banks for the 1979-80 data before the domestic financial liberalization began.

section analysis on the technology of commercial banks focusing on investigating "the economies of scale and scope." The other is the estimation study of technological progress in the banking industry using panel data.

According to our estimation results, the "economies of scale" was observed to be persistently present. The "economies of scope" was also partially observed in the Philippine banking industry. Despite the huge amount of investment in physical investment, technological progress in "Hicks' sense" was observed only in the level of marginal magnitude. These facts suggest that there is room for further reduction in operational costs by the domestic banks. This reduction can be achieved through expansion in operation size, operation diversification, and new technology introduction.

The organization and outline of this paper are as follows. Section 1 provides the background on Philippine financial reforms. Section 2 briefly describes the production technology of the banking industry and the behavior of banking institutions. Using financial data on the domestic commercial banks, we summarize their major business activities and gain insight on how the structure is changing in Section 3. The presence of "economies of scale" and "economies of scope" will be examined by estimating the annual bank cost function from 1988 to 1995 in Section 4. "Technological progress" will be measured using panel data covering a eight-year period (1988-95) in the next section. Section 5 briefly compares the features characterizing the production and cost structure of Philippine domestic banks with those of Thai domestic commercial banks. Section 6 evaluates progress in rationalization and efficiency gains for banks in the aftermath of financial reform. Lastly, this study will conclude with a recommendation that further financial liberalization in the future is necessary.

2. Changes in Production Activities of Domestic Commercial Banks

Before estimating the cost function in the following two sections, let us look at the shifting production activities of domestic banks in the economics analytical framework. First, we will summarize banking activities. Next, we will give an overview on the recent features of the Philippine domestic banking industry from four viewpoints. They are change in products, input of factors, price of factors, and cost and profit. These arguments will serve as a bridge to the following formal

estimation analysis and as the basic information for interpreting the estimated results.

A. Production Activity of Banks[5]

Just like other industries, one can think of a bank as an organization that uses factors of production as inputs and produces financial services as outputs. Bank products are financial services provided through various business operations. These services include extending loans, issuing deposits, dealing with foreign exchanges, trust operation, and many others. Major factors of production include funds raised through various forms, physical capital, and labor.

According to Clark (1984) and Kasuya (1994), the production activities of a bank can be summarized formally by the production function $F: R_{m+n} \rightarrow R$. Here $\boldsymbol{Y} = (Y_1, Y_2, \cdots, Y_m)$ and is a m-dimensional vector of banks outputs. $\boldsymbol{Q} = (Q_1, Q_2, \cdots, Q_n)$ is a n-dimensional vector of banks inputs.

(1) $F(Y,Q) = 0$

$\boldsymbol{P}=(P_1, P_2, \cdots, P_n)$ and is an n-dimensional vector of each factor price. If F is a strictly convex structure, a unique multi-product joint cost function C given by equation (2) can be constructed. Function C is homogenous of degree one, non-decreasing, and concave in P. Since the duality between the production function F and the cost function C exists, either function contains the same information about the banks' production technology.

(2) $C = C(Y, P) = min.P \cdot Q$

As asserted by Leland and Pyle (1977), it is widely recognized that efficient banking operation is intrinsically characterized by "economies of scale" and "economies of scope." According to studies by Gilligan and Smirlock (1984) and Gilligan et al (1984), "economies of scale" and "economies of scope" can be observed in the banking industry of industrialized countries.

In the joint production process, it is said that there exists "economies of scale" if the proportional increase in all joint productions requires lesser proportional increase

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[5] The analytical framework is basically the same as the one used in Okuda and Mieno (1996).

in the cost of production. Generally, for any industry characterized by large amount of fixed costs with its average costs decreasing, this implies that there is "economies of scale.". The banking industry requires a significant amount of fixed cost to maintain branch networks and computer on-line systems regardless of fluctuations in the business operation.

"Economies of scope" emerges in the joint process of production when some factors of production are shared or utilized jointly without congestion. Gilligan et al (1984) states that this interdependence is expected to be prevalent in the banking industry. The various financial services provided by the banking industry require similar skills[6] and banks maintain similar information on customer profiles. Therefore, physical capital such as branch network, computer system, and personnel can be utilized jointly without congestion.

Over time, progress in technology will be seen as the major source of reducing banking operational cost. For example, new technologies such as computer on-line systems and ATM help reduce the operational cost. New technologies also allow the banks to increase their income and expand product services into new fields such as credit card business, telephone banking, and virtual banking.

In the following analysis in Section 2, 3, and 4, we will focus on these three factors of production technology. Production technology is also the major policy target of recent Philippine financial reforms. We will look at the existence of "economies of scale and scope" and the characteristics of "technological progress" in the Philippine banking industry.

B. Outputs of Philippine Domestic Banks

If banks can meet the changing needs of financial services that arise from the relaxing of financial regulations, banking operations will become multi-faceted. The Philippines eased its banking regulations and introduced universal banking at the beginning of the 1980s. As a result, the volume of "off-balance sheet" business operations[7] in the Philippine banking sector grew, unlike the situation in other ASEAN

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[6] These skills include skills of screening, monitoring, and handling customers.

[7] Such business operations include the use of foreign currency deposits to extend foreign currency loans, the use of trust accounts in securities investment, etc. See Lambelte (1993) for

countries. This fact illustrates the substantial importance of "fee based businesses" in recent banking operations.

Looking at the Philippine domestic banking industry, we need to categorize the financial services. This is necessary in order to appropriately examine both the traditional loan business based on "balance sheet," and the fee-based business accompanied by "off-balance sheet" transactions. In examining bank business operations in the simplest way, we divide the financial services of the Philippine banks into two categories: the first is the so-called "loan business" category, or services that accompany traditional bank loan extending operations. The other is the "fee-based business" category, or all other activities which center around fee-based banking services.

In the previous study, the amount of bank outputs were measured in three different ways; first, in terms of the outstanding value of banks assets (loans extended). Secondly, in terms of the number of operations (i.e. number of deposits accounts). And thirdly, in terms of bank income (i.e. interest or non-interest income). However, the amount of "fee-based business" cannot be measured in terms of the first or the second method. In this study, we measure the sum of bank products by the current income of banks: Y_1 is the amount of "loan business" which is measured by "the interest income" from loans and deposits. Y_2 is the amount of "fee-based business" measured by the total non-interest income, or current income minus interest income.

Table-3 shows the diversification of bank operations. This is indicated by the ratio of revenues unrelated with "loan business" to total bank revenues, $Y_2/(Y_1+Y_2)$. According to this table, the indicator reached 20% or more in the second half of 1980s, higher than the other countries in the region and even higher than some developed countries. In the following discussions, we classify Philippine commercial banks into three categories, large, medium, and small banks, according to the size of their total assets: nine large-sized banks, eight medium-sized banks, and the remaining small-sized banks. The names of banks and their categories are listed in Appendix A.

However, a high diversification ratio for Philippine banks may have been exaggerated on account of special economic circumstances. In the late 1980s, high-

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more details.

yield "Treasury Bills" were issued in large volumes due to deteriorating budget deficits. This occurred while corporate demand for funds remained low in face of the economic slump. As a result, banks shifted from loans to public securities in their portfolios. It is for this reason why the diversification ratio appears to be raised upwards.[8]

Interestingly, in Table-2, this ratio shows a declining trend even though financial reform moved forward in the 1990s. The surge in bank loans contributed to this trend as the economy turned around in the 1990s. The ratio of loan revenues to the total revenues can be considered to be returning to the normal level. This may indicate that previous bank operations were actually a reflection of a distortion in the economy.

Table 2 Share of Non-interest Income to Total Income: $Y_2/(Y_1+Y_2)$

(%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	22.7	21.5	22.4	15.7	18.6	23.0	17.8	16.9	16.9
Medium	25.4	20.7	25.2	18.9	22.4	22.4	17.9	19.1	17.7
Small	23.7	21.0	27.9	15.0	21.5	21.1	17.3	18.4	17.8

(Source) Annual reports issued by individual banks, various issues.

C. Factor Inputs

Using Kasuya (1993) as reference, in this study we assume three major inputs of factors in banking activities. The three are raised funds $Q1$, labor $Q2$, and banks' physical capital $Q3$. The funds are raised through deposits and other types of borrowings. Pphysical capital consists of branch office buildings and business equipment such as computer systems, on-line systems, and etc. Labor includes bank tellers, managers, and executive officers. The three factors, $Q1$, $Q2$, and $Q3$, are measured respectively by the total amount of borrowed funds, the number of banks' employees, and fixed assets belonging to banks.

Judging from Table-3, one notable change in the recent pattern of factor inputs

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[8] Two reasons for high diversification ratio among Philippine banks are commonly mentioned: (1) Trust business ratio is high; its operations are biased towards wealthy clients. (2) Non-lending income is bolstered by the sale of collateral (usually real estate) from bad debts. See Okuda (1996) and Paderanga (1995).

among Philippine banks is the steadily increasing trend of capital-labor ratio (physical capital equipment ratio for each bank employee), Q_3/Q_2. While both inputs of labor and physical capital have rose continuously, the rate of increase is faster for physical capital, indicating that the banking industry is moving toward a more capital-intensive structure.

Against the background of policies that were aimed at rejuvenating economic growth and competition-promoting measures such as new branch office de-regulations, ATM and branch office openings have increased rapidly. Modernization investments such as on-line computer networks have also been on the rise. New services based on new technology such as ATM, telephone and virtual banking, have become important for gaining customers in the more competitive market[9]. Large banks have higher rate of new service offerings than small and medium-sized banks, an indication of a more capital-intensive production method. However, in terms of the relative speed of increase in new services, small and medium-sized banks exceeded large banks.

Table 3 Physical Capital Per Employee : Q_3/Q_2

(million Peso)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	0.19	0.21	0.30	0.35	0.40	0.43	0.48	0.57	0.74
Medium	0.11	0.11	0.13	0.19	0.28	0.31	0.35	0.51	0.61
Small	0.12	0.13	0.11	0.14	0.22	0.26	0.35	0.50	0.49

(Source) Same as Table 2.

According to Table-4, changes in the factor productivity of Philippine banks correspond to those in the factor input ratio. Average labor productivity, $(Y_1+Y_2)/Q_2$ improved significantly from the end of 1980s to the early 1990s, though it has remained stagnant since. However if adjusted for price changes, one can say that the improvement has been moderate. Productivity has always been higher in large banks than in small and medium-sized banks, illustrating the superior labor productivity of large banks. Average productivity of physical capital $(Y_1+Y_2)/Q_3$ rose at the end of 1980s, but has been on a descending trend into the 1990s. The fluctuation in the productivity of physical capital for small and medium-sized banks is even greater than in large banks.

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[9] See, for instance, Paderanga (1995).

Table 4 Change in Average Factor Productivity

Ratio of total income to borrowed funds: $(Y_1+Y_2)/Q_1$ (%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	15.2	13.8	18.4	17.6	15.7	13.4	12.8	13.0	13.6
Medium	13.4	12.1	18.7	20.5	15.5	14.2	13.3	14.5	13.9
Small	19.5	22.1	23.6	21.6	17.5	17.2	17.4	13.2	12.9

Average productivity of labor : $(Y_1+Y_2)/Q_2$ (million Peso)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	0.82	1.08	1.59	1.72	1.65	1.51	1.63	2.21	2.77
Medium	0.69	0.74	1.29	1.41	1.30	1.27	1.35	1.80	2.34
Small	0.60	0.88	0.96	0.97	1.00	1.25	1.37	1.43	1.52

Average productivity of physical capita : $(Y_1+Y_2)/Q_3$

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	4.19	5.07	5.24	4.99	4.08	3.52	3.59	3.46	3.72
Medium	6.52	6.58	993	7.24	4.71	4.10	3.91	3.53	3.79
Small	5.01	6.88	8.98	6.93	3.98	4.82	4.03	2.88	3.11

(Source) Same as Table 2.

If comparison is made among banks of different sizes, large banks having higher capital-labor ratio than small and medium-sized banks. Large banks also engage in more capital intensive operations. Their capital-labor ratio is high, resulting in the highest labor productivity among the three types of banks. Like the large banks, the small and medium-sized commercial banks have also increased physical capital investment. Hence the steady rise in the capital-labor ratios.

However, these banks still have lower ratios relative to large banks, and their operations are more labor intensive. Although they exceeded large banks in the productivity of physical capital, the gap has narrowed significantly in the 1990s. Large banks are gradually enjoying an advantageous position in factor productivity.

D. The Change in Factor Prices

The movements of factor prices are summarized in Table-5. Price of raised funds P_1 is measured by average interest rate on banks borrowed funds. It is generally believed that large banks have advantages over small banks. Large banks have the ability to raise low-cost funds through their deposits, with the help of extensive branch

office networks. In the Philippines however, the cost of raising funds is higher for large banks with large number of branch offices. Some large banks borrow from small banks in order to compensate for fund shortage.

Table 5 Change in Factor Prices

Price of raised funds: Total Interest Expenses/*Q1*

(%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	5.54	7.15	9.35	8.81	6.81	4.97	5.23	5.74	6.00
Medium	5.86	6.29	7.68	9.74	6.75	5.71	5.15	5.81	6.17
Small	8.12	7.65	8.98	9.75	7.29	6.05	5.59	5.31	5.25

Price of labor: Total Payroll Expences/ *Q2*

(thousand Peso)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	122.8	131.6	159.5	186.0	203.2	215.6	226.3	293.9	338.4
Medium	97.8	97.1	148.1	153.6	166.9	186.7	198.2	257.8	285.6
Small	82.3	96.0	139.4	147.9	143.2	171.1	172.8	192.6	200.1

Average Cost of Physical Capital: Equipment Expenses/ *Q3*

(%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	24.1	23.6	30.4	28.8	27.6	30.2	30.4	24.7	23.7
Medium	40.6	43.6	38.3	29.7	31.1	35.3	40.5	22.5	21.1
Small	20.8	40.3	35.4	33.3	33.1	36.3	35.5	23.2	23.8

(Source) Same as Table 2.

Savings deposit comprise a predominant part of bank deposits in the Philippines, yet interest rates are extremely low and almost always negative in real terms. In fact, real fund-raising costs have been negative except for one period and stayed well below regional standards. Fund shortages in large banks and negative real deposit rates are key features of the Philippine banking industry.

Judging from Table-5, we can observe that while the price of labor P_2 kept rising, the price of physical capital P_3 did not change discernibly. P_2 and P_3 are measured respectively by average wage of bank employees and average rental rate. The rise in wages can be attributed to the recovery of the Philippine economy in the 1990s. This resulted in the wide-spread headhunting activities for senior and junior bank executives. The wage rise has also been attributed to the entry of new foreign

banks into the domestic market, intensifying competition among local and foreign banks for experienced employees.[10]

The highest average wage is found in the large banks, and the lowest average wage is found in the medium-sized banks. Although wage levels have risen in real terms, there has been no change in the wage structure; the larger the bank, the higher the wage. While it is difficult to conceive an appropriate cost-indicator of physical capital, no clear difference is observable among banks of different sizes.

It appears that changes in the relative price of labor and physical capital correspond to the change in factor intensity. Relative cost of labor keeps growing, suggesting that the change in relative factor prices may be considered as a factor for explaining the shift toward a more capital-intensive production structure.

E. Operational Costs and Profits

Composition of bank operating expenses is shown by Table-6. Concerning operating expenses of Philippine banks, the largest share is taken up by "fund-raising cost" P_1Q_1, followed by "personnel expenses" P_2Q_2, and "materials cost" P_3Q_3. According to Table-6, the composition of the ratio of bank operating expenses to total costs varies greatly in the Philippines. This is caused mainly by fluctuations in the fund-raising cost. Interest rates in the Philippines rose in the early 1990s, which led to an initial rise in the ratio of fund raising cost P_1Q_1/C and later, a decline. The sum of ratios of fund raising cost, personnel cost, and materials cost relative to total cost, is found to be less than 60%. This is attributable to the fact that reserve requirement reached as high as 20% or above in the Philippines. It is also due to the fact that high implicit tax is levied upon bank operating incomes.

When we compare these ratios for banks of different sizes, large banks have lower personnel cost ratio, suggesting superior labor-cost performance. With respect to ratios for fund-raising and material costs, no consistent trend is observable as ranking changed for all groups at different time periods. Comparing these ratios with the level in other countries, a notable finding exists.

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[10] Interviews conducted by the author reveals that general office workers have lower wages than public servants. Headhunting activities do not apply to these workers. See Okuda (1996).

Table 6 Change in Operating Expenses

Ratio of fund-raising expense to total income: $P_1Q_1/(Y_1+Y_2)$ (%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	41.9	46.3	50.7	50.2	43.2	37.5	41.0	44.2	44.3
Medium	43.4	43.7	40.7	48.5	44.1	40.2	39.0	40.3	44.3
Small	42.1	36.3	39.7	44.8	42.3	36.4	32.5	41.9	41.9

Ratio of payroll expense to taotl income: $P_1Q_2/(Y_1+Y_2)$ (%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	15.1	12.6	10.5	11.2	12.8	14.7	14.1	13.3	12.3
Medium	14.3	14.1	12.3	11.4	13.7	15.4	15.2	14.5	13.3
Small	18.0	15.0	14.8	15.9	16.1	15.3	13.9	13.8	12.7

Ratio of equipment expense to total income: $P_3Q_3/(Y_1+Y_2)$ (%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	5.7	5.0	5.6	5.7	6.8	8.7	8.6	7.4	6.8
Medium	6.3	5.7	4.0	4.5	7.3	9.3	9.8	6.2	5.2
Small	4.1	5.9	3.7	4.8	8.5	9.3	9.8	8.8	8.5

(Source) Same as Table 2.

As illustrated in Table-7, while profit rate of total assets rose in the beginning of 1990s, it later decreased. The averaged profit rate in the Philippines was neither extremely high nor extremely low. When comparing banks of different sizes for a change in the rate of profit, large banks have the highest rate of profit. Small and medium-sized banks often experience volatile fluctuations in their profits, suggesting unstable business activity.

Table 7 Ratio of Operational Income to Total Asset (before tax)

(%)

	1988	1989	1990	1991	1992	1993	1994	1995	1996
Large	2.02	2.60	2.92	2.91	2.83	2.54	2.33	2.21	2.47
Medium	1.78	1.79	3.42	3.03	2.42	2.20	2.17	2.46	2.24
Small	1.80	1.88	3.94	3.21	2.52	3.30	3.29	2.24	2.61

(Source) Same as Table 2.

3. The Estimation of Cost Functions

Analysis in the previous section suggests that banks in the Philippines are pushing forward diversification in their operations and branch network expansion. They are also actively pursuing modernization investments in response to the recent financial reforms and new market competition. Although domestic banks are expected to adjust their operations to the new changes, production technology of the banking industry cannot be examined in a comprehensive manner simply by analyzing the financial data. In the following two sections, the cost function of the Philippine banking industry will be investigated in a formal econometric analysis.

A. The Method of Estimation

In Section 4, banks' production technology is examined using yearly cross-section data from the late 1980s to the first half of the 1990s. In estimating the cost function, this analysis brings into focus "economies of scale" and "economies of scope," generally recognized to be the major policy objectives of recent financial reforms. Leyland and Pyle (1977) in their study, claims that these economies are presumed to exist inherently in the banking industry. This is characterized by large fixed costs and common factors of production. Large fixed costs lead to a decrease in the average cost of production.

Financial reform in the Philippines seeks to exploit such effects. If banks are indeed pursuing efficient operation in a competitive environment, then "economies of scale" and "economies of scope" would be observed in the data. Similar to Okuda and Mieno (1996), the estimation method used by Kasuya (1994) will be used. Assume the following trans-log cost function with three factors and two products:[12]

$$\ln C = \alpha_0 + \sum_{k}^{2} \alpha_k \ln Y_k + \sum_{j}^{3} \beta_j \ln P_j + \frac{1}{2}\sum_{h}^{2}\sum_{i}^{2} \delta_{hi} \ln Y_h \ln Y_i + \frac{1}{2}\sum_{l}^{3}\sum_{m}^{3} \gamma_{lm} \ln P_l \ln P_m \tag{3}$$

By normalizing the values of all variables around the mean values, the trans-log

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[12] All notations have the same representation as the ones used in the previous section.

cost function can be recognized to be a second order approximation of the cost function based on the mean values.

Equation (3) should have all the desirable characteristics of the cost function; i.e., symmetry between intersect terms (4a), monotonicity of production and factor prices (4b), linear homogeneity on factor prices (4c), and the second order condition for cost minimization (4d).

$$\text{(4a)} \quad \delta_{hi} = \delta_{ih} \quad (h,i = 1,2), \quad \gamma_{lm} = \gamma_{ml} \quad (l,m = 1,2,3)$$

$$\text{(4b)} \quad \alpha_k > 0 \quad (k = 0.1.2), \quad \beta_j > 0 \quad (j = 2,3)$$

$$\text{(4c)} \quad \sum_{j}^{3} \beta_j = 1, \quad \sum_{l}^{3} \gamma_{lm} = 0 \quad (m = 1,2,3)$$

$$\text{(4d)} \quad Hp\left[\frac{\partial^2 C}{\partial P_l \partial P_m}\right] \leq 0 \quad (l,m = 1,2,3)$$

To ensure sufficient degree of freedom in estimation and to simplify the estimation work, linear homogeneity on prices of products, as in Kasuya (1994) and Okuda and Mieno(1996) will also be assumed.

$$\text{(5)} \quad \sum_{h=1}^{3} \delta_{hi} = 0 \quad (i = 1,2) .$$

In order to handle the estimation with constraints, the above listed conditions (4a), (4c), (4d), and (5) are substituted into cost function (3) to have the following estimated equation.[13] The constraint (4b) will then be checked from the results of equation (6).

$$\text{(6)} \quad \begin{aligned} \ln C - \ln P_3 = {} & \alpha_0 + \alpha_1 \ln Y_1 + \alpha_2 \ln Y_2 + \beta_1(\ln P_1 - \ln P_3) + \beta_2(\ln P_2 - \ln P_3) \\ & + \frac{1}{2}\delta_{11}(\ln Y_1 - \ln Y_2)^2 \end{aligned}$$

The total elasticity of scale on overall production is represented by formula (7) for the cost function $C = C(tY_1, tY_2, P_1, P_2, P_3)$. "Economies of scale" exist, if $\alpha_1 + \alpha_2 < 1$ and vice versa. "Economies of scope" exist if the following complementarity

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13 See Appendix B, for details.

of scope holds.[14] In other words, if the value of formula (8) is strictly less than zero, then economies of scope exist. Since actual estimation is conducted in the proximity of the mean values $\ln Y_1 = \ln Y_2 = 0$, the condition holds if $\delta_{12} + \alpha_1\alpha_2 < 0$.

$$(7) \quad \frac{\partial C}{\partial t} = \frac{\partial \ln C}{\partial \ln Y_1} + \frac{\partial \ln C}{\partial \ln Y_2} = \alpha_1 + \alpha_2$$

$$(8) \quad \frac{\partial^2 C}{\partial Y_1 \partial Y_2} = \frac{C}{Y_1 Y_2}\left\{\delta_{12} + \left(\alpha_1 + \delta_{11}\ln Y_1 + \delta_{12}\ln Y_1\right) \bullet \left(\alpha_2 + \delta_{21}\ln Y_1 + \delta_{22}\ln Y_1\right)\right\}$$

B. Data Used

Data used in the estimation are based on banks' self-issued financial statements at the end of each fiscal year. The financial data of individual banks listed at the stock market are available from the Philippine Stock Exchange. The number of bank employees for each bank is taken from various issues of *A Study of Commercial Banks in The Philippines*, annually published by SGV & Co.[15] Data availability of individual banks are summarized in Appendix A. The value of individual variables used in the estimation are calculated as follows.

Y_1 = (Interest Income from loans and deposits)
Y_2 = (Total non-interest income)
P_1 = (Total interest expense) / { (Deposits) + (Borrowing from financial institutions) + Other debts))}
P_2 = (Payroll expenses) / (Number of employees)
P_3 = { (Equipment expenses) + (Premise expenses) } / (Fixed assets)
C = (Total interest expenses) + (Equipment expenses) + (Premise expense) + (Payroll expenses)

C. Results of Estimation

Table-8 summarizes the result of Non-linear Least Squares (NLS) estimation of equation (4), the cost function for Philippine domestic banks. The equation was estimated using cross section data for each year, spanning an 8-year period from 1988 to

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[14] See Kasuya (1994) for more detailed discussion.

[15] Sycip Gorres Velayo & Co. is one of the largest accounting and consulting company in the Philippines, which is a member firm of Arthur Andersen & Co.

Table 8A The Estimated Results of Domestic Banks Cost Function: Cross Section Analysis

	α_0	α_1	α_2	β_1	β_2	β_3	δ_{11} δ_{22}	δ_{12} δ_{21}	*Economies of Scale*	*Economies of Scope*	No. of Observations	Adj. R.
1988												
coefficient	-0.025	0.637	0.268	0.445	0.922	-0.367	0.342	-0.342	0.905	-0.171	15	0.943
t-value	-0.332	3.480	1.153	2.588	10.099		0.520	-0.520	0.903	0.124		
1989												
coefficient	-0.066	0.788	0.100	0.330	0.926	-0.256	0.980	-0.980	0.888	-0.901	16	0.978
t-value	-1.037	5.965	0.756	2.031	14.870		1.519	-1.519	5.130	2.890		
1990												
coefficient	-0.088	0.652	0.305	0.574	0.923	-0.497	1.052	-1.052	0.957	-0.853	16	0.993
t-value	-2.894	10.491	4.842	6.648	25.399		4.579	-4.579	3.525	14.252		
1991												
coefficient	0.018	0.840	0.100	0.459	0.896	-0.355	-0.272	0.272	0.940	0.356	18	0.959
t-value	0.294	6.265	0.650	2.384	11.594		-0.489	0.489	0.894	0.553		
1992												
coefficient	0.044	0.827	0.106	0.402	0.890	-0.292	-0.800	0.800	0.933	0.888	18	0.980
t-value	1.487	10.855	1.280	4.020	11.129		-2.434	2.434	1.735	7.746		
1993												
coefficient	-0.029	0.733	0.155	0.365	0.750	-0.115	0.432	-0.432	0.888	-0.318	18	0.960
t-value	-0.564	4.901	0.965	1.778	8.025		0.798	-0.798	4.107	0.660		
1994												
coefficient	-0.029	0.867	0.072	0.605	0.800	-0.405	0.508	-0.508	0.939	-0.446	18	0.977
t-value	-0.760	8.084	0.683	3.460	14.927		1.248	-1.248	2.019	1.986		
1995												
coefficient	0.023	0.796	0.243	0.859	0.916	-0.775	-0.642	0.642	1.039	0.514	16	0.990
t-value	0.774	10.941	2.976	7.465	23.772		-0.974	0.974	2.013	2.306		

$C(zY, P_1, P_2, P_3)$, is given by equation (10). This is the indicator of the existence of "economies of scale." That is, if the value of formula is strictly less than unity $a_1 + a_2(lnY_2) < 1$ (and vice versa), economies of scale exist.

$$(10) \quad \frac{\partial C}{\partial z} = \frac{\partial \ln C}{\partial \ln Y} = a_1 + a_2 \ln Y$$

"Technical progress" of the banking sector with production function (7) is defined as $\Psi \equiv \frac{\partial \ln Y}{\partial t}$, and for the cost function (8) as (11). There, d_1 denotes technical progress at time t (with base year $T = 0$), and d_2 is the rate of change of technical progress. e_n denotes the bias in technology progress "in the sense of Hicks" where $e_n = 0$ indicates neutral technical progress with respect to the n-th factor.

$$(11) \quad \Psi \equiv -\frac{\partial \ln C}{\partial T} = -(d_1 + 2d_2 T + \frac{1}{2}\sum_{1}^{3} e_n \ln P_n)$$

B. Results of Estimation

In estimating the cost function by nonlinear least squared method, annual panel data from 1988 to 1995 for the top- 14 banks is used. The other banks was excluded from the estimation, since the data spanning the entire observation period is not available. Table-9 summarizes the results of the estimation, conducted for real data obtained by dividing the nominal data with consumer price index. In Table-9, the estimated results using the panel data during the 1988-1995 period is described in Table-9A. The estimated results using the data in the 1988-1991 and 1992-1995 periods are given by Table-9B and 9C, respectively.

Looking at the results, we may say that the major explanatory variables including variables a_1, b_k, d_1, e_l have the expected signs and the statistical significance with high t-values. The explanatory power of the estimated equation is satisfactory with adjusted R-squared value. While the fitness of the estimation differs among Table-9A, 9B, and 9C, in general the findings in Table-9 are acceptable.

Economies of scale can be observed from the fact that coefficient estimates in all estimated periods fulfill the condition $a_1 + a_2(lnY_2) < 1$. This finding is

1995. Table-8A shows the result from a sample of large and medium banks only, while Table-8B covers large, small, and medium-sized banks. For some small banks, data is not available for the whole period except for a limited number of banks.[16] For the remaining small banks, available data is fragmented in intermittent periods.

Recently, new firms have been entering the domestic banking business every year in the Philippines. These banks are small in size and differ from existing banks in their scope of business and cost structure.[17] If our analysis is to be credible, it is more appropriate to select a data set that covers only large and medium-sized banks (see Table-8A). This data set is available continuously over the sample period and their operational patterns are more stable and established. Appendix A shows the list of banks used for estimations in Table-8A and 8B.

In both Table-8A and 8B, the *t*-values are small for α_2 and δ_{hi} except for a few periods. Estimates of coefficient β_3 show results converse to what was expected. This is also the case for δ_{hi} in certain periods. However, other coefficients are the same as what was anticipated and that the *t*-values are also satisfactory. The coefficient of determination R^2 is high, and coefficient values are stable across the entire sample period. We can conclude that the results are generally satisfactory[18].

When the significance level of coefficients was examined α_2, the coefficient of "revenues from activities other than loans" had low t-values, leading to the conclusion that cost level is not correlated with Y_2. As shown in Table-2, Philippine banks have traditionally been highly diversified in their operations. The result seems to contradict this fact.

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[16] This is due to constraints on obtaining data.

[17] Some new small-sized banks operate as deposit-taking companies. These banks simply re-lend the funds to other large banks or invest in public bonds. These new banks seem to lack the ability to operate banking business.

[18] Compared with the estimation results for Thai commercial banks in Okuda and Mieno (1996), the result is much more satisfactory in terms of theoretical appropriateness (i.e., signs of the estimated coefficients), statistical significance of coefficients (i.e., *t*-values), and fitness of estimated equations (i.e., values of R^2).

What happened in reality is that diversification took place against the background of poor growth in lending, a result of the sluggish economy. Another reason is the increased share of public securities in the banks' asset portfolio due to soaring fiscal deficits. In this sense, the result is not necessarily contradictory. The central part of public securities holding consists of safe and high-yield treasury bonds and its relevant operating cost is minuscule relative to the revenues generated.

Therefore, it is not unnatural that operating cost for ordinary lending accrued from approval and management was high, relative to revenues in part due to the deteriorating economic conditions. Thus, our results are not inconsistent with Table-2 of the previous section.

Let us turn now to an indicator of "economies of scale." From Table-8B, "economies of scale" is observed across the entire sample period except for 1993. The likelihood ratio test for equation (8) produced high values except for the years 1988 and 1991. Since a rise in revenue from 1989 to 1990 was induced by interest rate hikes, economies of scale may be over-represented in our estimates. Nonetheless, it may be generalized that the Philippine banking industry has had significant "economies of scale".

In the Philippines, Table-8A and Table-8B indicate that except for 1991 and 1992, the criteria equation (8) became negative, that is; there existed "economy of scope". Table-8A shows the likelihood ratio for the criteria, equation (8). Less than zero is large except for the years 1988 and 1991, suggesting "economy of scope" as banks diversify their operations. However, given that t-values for α_2 and δ_{12} are low except for a few periods, we have to be cautious about drawing a definite conclusion from this finding.

It has been pointed out that due to its intrinsic nature, banking business is characterized by "economies of scale" and "economies of scope." "Economies of scale" with statistical significance for domestic banks in the Philippines is observed in the above findings. "Economy of scope" is also observed in some periods. While it has been said that these banks remained in non-competitive environment to date,[19] the findings above reveal that some effort has been made to maintain efficient production of

[19] For instance, see Lamberte (1993), Lamberte and Llanto (1993), and Tan (1991).

banking services. According to many previous studies that investigated banking industry in industrialized countries, "economies of scope" have been observed less frequently than "economies of scale," suggesting the same picture when the Philippine banks are being compared.

4. A Shift of Bank Cost Function over Time and Technical Progress

Estimation in the previous section examined cost structures for each year, using cross section data. This section uses panel data from 1988 to 1995, and determine if there is a shift over time in the cost function of Philippine domestic banks. A time dummy variable is introduced in the cost function in order to measure explicitly a shift in production technology during the observation period. Estimation method in principle, is a simple time trend approach as used in Kasuya (1993).[20]

A. Estimation Method

The findings in the previous section fail to identify at a statistically significant level, that revenues from nontraditional operations (i.e., those other than lending) have effect on banking sector's operating cost. Thus using panel data in this analysis, the output of the banking industry is treated as a single product. Let Y_{it} denote financial service produced by banks at t-th period, and Q_{1it}, Q_{2it}, and Q_{3it} represent the funds raised by banks, labor, and physical capital.[21] Using simple time-dummy approach, the t-th period production for the i-th bank can be expressed as :

$$(9) \quad Y_{it} = G(Q_{1it}, Q_{2it}, Q_{3it})$$

Modifying the cost function (3), we assume that the t-th period cost function for the i- th bank is represented by the trans-log cost function (10). Assume further that operating efficiency in equation (10) differs from bank to bank, and that efficiency factor for the i-th bank is a stochastic variable μ_i, where $\mu_i \geq 0$, $Var(\mu) = \sigma^2$. Time variable T $(T = t)$ represent the effect of time passage over the production cost. Other variables follow those in the cost function as in the previous section. We will estimate this equation using panel data.

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[20] For more details in time trend approach, see Caves et al. (1981).

[21] The three inputs are used in the production process at time t.

$$\ln C_{it} = a_0 + a_1 \ln Y_{it} + \frac{1}{2} a_2 (\ln Y_{it})^2 + \sum_k^3 b_k \ln P_{kit} + + \frac{1}{2} \sum_l^3 \sum_m^3 c_{lm} \ln P_{li} \ln P_{mi}$$

(10)

$$+ d_1 T + d_2 T^2 + \frac{1}{2} \sum_1^3 e_n T \ln P_{nit} + \mu_i + v_{it} \qquad (i = 1,2, \quad , N)$$

In order for this cost function to be meaningful in the economics sense, the following four constraints should be met as in the previous section. They are: symmetry of cross terms (11a), monotonicity with respect to production and factor prices (11b), linear homogeneity with respect to factor prices (11c), and the second order condition of cost minimization (11d).

(11a) $c_{lm} = c_{ml}$ (l , $m = 1, 2, 3$)

(11b) $b_k > 0$ ($k = 1,2,3$)

(11c) $\sum_k^3 b_k = 1$ ($j = 1,2,3$), $\sum_l^3 c_{lm} = 0$ ($l, m = 1,2,3$)

(11d) $Hp\left[\frac{\partial^2 C}{\partial P_l \partial P_m}\right] \leq 0$ ($l, m = 1,2,3$)

In general, estimation of equation (10) with these constraints requires specification of μ_i . However, it is known that if the "within estimator" is used, unbiased estimates of parameters a_j, b_k, c_m, d_q, e_n can be obtained without specifying the distribution of μ_i . In other words, the procedure is first to estimate equation (10) given constraints (11a) and (11c). Then the consistency of the parameters obtained with (11b) and (11d) is checked.

In the actual estimation process, equation (10) is "within transformed" first, and the obtained cost function is estimated by the constrained GLS estimator. Constraints will be applied: first estimate equation (10), imposing cross-term symmetricity condition and linear homogeneity condition with respect to factor prices. Thereafter, consistency of parameter estimates is checked with the monotonicity condition, with respect to factor prices and the second order condition.

The total elasticity of scale on the overall production for cost function $C = C(zY, P_1, P_2, P_3)$, is given by equation (11). This is the indicator of the existence of "economies of scale." That is, if the value of formula is strictly less than unity $a_1 +$

$a_2(lnY_2) < 1$ (and vice versa), economies of scale exist.

$$(12) \quad \frac{\partial C}{\partial z} = \frac{\partial \ln C}{\partial \ln Y} = a_1 + a_2 \ln Y$$

"Technical progress" of the banking sector with production function (9) is defined as $\Psi \equiv \frac{\partial \ln Y}{\partial t}$, and for the cost function (10) it is represented by the formula (13). Here, d_1 denotes technical progress at time t (with base year $T = 0$), and $d_2 = \frac{\partial^2 \ln C}{\partial T^2}$ is the rate of change in technical progress. e_n denotes the bias in technical progress in the sense of Hicks where, if $e_n = 0$, technical progress is neutral with respect to the n-th factor.

$$(13) \quad \Psi \equiv -\frac{\partial \ln C}{\partial T} = -(d_1 + 2d_2 T + \frac{1}{2}\sum_{1}^{3} e_n \ln P_n)$$

B. Results of Estimation

In estimating the cost function by nonlinear least squared method, annual panel data from 1988 to 1995 for the top- 14 banks is used. The other banks was excluded from the estimation, since the data spanning the entire observation period is not available. Table-9 summarizes the results of the estimation, conducted for real data obtained by dividing the nominal data with consumer price index. In Table-9, the estimated results using the panel data during the 1988-1995 period is described in Table-9A. The estimated results using the data in the 1988-1991 and 1992-1995 periods are given by Table-9B and 9C, respectively.

Looking at the results, we may say that the major explanatory variables including variables a_1 , b_k , d_1 , e_1 have the expected signs and the statistical significance with high t-values. The explanatory power of the estimated equation is satisfactory with adjusted R-squared value. While the fitness of the estimation differs among Table-9A, 9B, and 9C, in general the findings in Table-9 are acceptable.

Economies of scale can be observed from the fact that coefficient estimates in all estimated periods fulfill the condition $a_1 + a_2(lnY_2) < 1$. This finding is

Table 9 The Estimated Results of Domestic Bank Cost Function: Panel Data An

	Table 9A		Table 9B		Table 9C	
	Real Values		Real Values		Real Values	
	coefficients	*t*-value	coefficients	*t*-value	coefficients	*t*-value
a0	0.060	1.518	0.195	1.676	-0.215	-0.587
a1	0.783	16.933	0.887	7.393	0.872	12.366
a11	0.064	0.363	-0.017	-0.034	0.411	0.695
b1	0.583	8.501	0.096	0.259	0.991	2.095
b2	0.281	4.170	0.738	2.168	0.218	0.427
b3	0.136		0.166		-0.209	
c11	-0.127	-0.584	-1.001	-0.903	-0.248	-0.418
c12 , c21	0.223	0.879	1.703	1.927	0.464	0.481
c13 , c31	-0.195	-1.796	0.248	0.934	-0.423	-1.013
c22	-0.396	-0.798	-2.237	-2.345	-0.494	-0.315
c23 , c32	0.156	0.483	0.67	1.318	-0.266	-0.445
c33	-0.077		0.033		0.186	
d1	-0.054	-3.031	-0.130	-1.43	0.028	0.251
d11	0.007	3.837	0.02	1.176	0	0.052
e1	-0.114	-3.676	0.19	0.606	-0.251	-1.696
e2	-0.074	-1.939	-0.524	-2.034	-0.076	-0.484
e3	-0.033	-2.429	-0.077	-1.362	0.072	1.213
Economies of Scale	0.783		0.887		0.871	
Technological Progress	0.002 *		0.071 *		-0.030 *	
No. of Observations	112		56		56	
Adj. R.	0.947		0.956		0.954	
Estimation Period	1988--1995		1988--1991		1992--1995	

(Note) *Progress per year

consistent with the cross section analysis in the previous section, and underscores the view that "economies of scale" exist in Philippine domestic banks.

When the indicators of technical progress $\Psi \equiv -\frac{\partial \ln C}{\partial T} = -(d_1 + 2d_2 T + \frac{1}{2}\sum_1^3 e_n \ln P_n)$ were evaluated, Table-9 suggests mixed results. According to the estimation over the 1988-1995 period, the indicator of technical progress is positive, which suggests a reduction in banks operational cost was not due to either decrease in outputs or factor prices. However, the estimation results in Table-9B and 9C are opposite, which shows that technical progress was observed in the 1988-1991 period and not in the 1992-1995 period.

When factors for technical progress were examined, the similar pattern as described above was again observed. According to the estimated results for the 1988-1995 period, coefficients e_n (n = 1, 2, 3) are negative with high t-value. In particular, e_1 has large absolute value with high t-value, suggesting that the technical progress is of the "raised funds-saving" character. However when comparing Table-9B with 9C, the technical bias differs between the two periods. In the 1988-1992 period, e_2 has the largest absolute value with the highest t-value, implying that technical progress was of the "labor-saving" type. In the 1992-1995 period, e_1 has largest absolute value with highest t-value, implying technical progress changed to be of the "raised funds-saving" type.

As described in the financial analysis of Section 2, investments in physical capital have been on the rise in the 1990s, as the country prepares itself for future market competitions. Responding to the new market circumstances, Philippine domestic banks expanded branch networks and modernization investments such as computer on-line systems and ATM installations.

In the years 1988-1991, expansion of physical capital resulted in the reduction of operational cost. Yet in the years 1992-1995, expansion in physical capital in response to competition was so rapid that the increase in the cost of physical investment overwhelmed the reduction of operational cost resulted from improvements in labor productivity. Consequently, production technology became more capital-consuming and weakly labor-saving.

Interestingly, the "raised fund-saving" type technical progress in the 1992-95 period corresponds to the fact that the Philippine domestic banks have eagerly suppressed the expansion of their assets. This was done to keep their capital adequacy ratios high, in order to improve their credit-worthiness. It is commonly recognized that keeping the capital adequacy ratio high is essentially important to survive in the intensifying market competition. Expansion of the off-balance transactions and capitalization of loans are common methods used to raise the capital adequacy ratio. These efforts may result in the observed "raised fund-saving" effects on the production technology of banking industry.

5. Comparison with Thai Domestic Banks

The financial analysis of Philippine domestic banks (section 2) and the estimation of their cost functions (section 3 and 4) give us several features characterizing the production and cost structure of Philippine domestic banks. This section briefly compares these features the business operations of Philippine domestic banks with those of Thai commercial banks. The features of Thai commercial banks come from the study of Okuda and Mieno (1996) on the microeconomic behavior of Thai domestic banks using a similar analytical framework.

A. Comparison of Business Operations

The market circumstances surrounding domestic banks in the Philippines and Thailand in the 1990s were basically quite similar. In both countries, a series of financial reforms were undertaken in the late 1980s and 1990, which were strongly characterized by competition-promoting policies. And their macroeconomic environments were favorable: Thailand experienced high economic growth and the Philippines achieved a certain degree of economic stability. While the market competition intensified in the banking sector, favorable business chances expanded for domestic banks.

In response to this change in the market environment, domestic banks shifted their business operations. Based on our discussions in the previous sections and Okuda and Mieno (1996), Table-10 summarizes the changes in business operations of Thai and Philippine domestic commercial banks. From this table, we can see the similarities and the differences between the Philippines and Thailand.

Table 10. Cost and Production Structure of Philippine and Thai Domestic Banks

	the Philippines	Thailand
Production Structure (Observation period)	1988-1996	1985-1993
Capital-labor ratio	*large* Up 289 % *medium* Up 455 % *small* Up 308 %	*large* Up 243 % *medium* Up 109 % *small* Up 233 %
Labor productivity	*large* Up 239% *medium* Up 239% *small* Up 153%	*large* Up 86 % *medium* Up 124 % *small* Up 89 %
Share of non-interest income	*large* 23 % → 17 % *medium* 25 % → 18 % *small* 24 % → 18 %	*large* 4 % → 10 % *medium* 5 % → 8 % *small* 6 % → 9 %
ROA*	*large* 2.9 % → 2.5 % *medium* 3.4 % → 2.2 % *small* 3.9 % → 2.6 %	*large* 0.7 % → 2.3 % *medium* 0.5 % → 1.6 % *small* 0.5 % → 1.4 %
Technology of Production (Observation period)	1988-1995	1985-1993
Economies of Scale	observed	observed
Technical progress	*1988-91*: labor-saving type *1992-95*: fund-saving type	labor-saving type

(Source) For the Philippines, Tables contained in this paper. For Thailand, Okuda and Mieno (1996)

(Note) *For the Philippine, the change in the 1990-96 period.

For the similarities, in both countries, domestic commercial banks increased the investments in modernization and expanded their branch networks. At the same time, production of banking services changed to become more capital intensive in both countries. Corresponding to the change in the capital-labor ratio, labor productivity improved significantly. However, in comparison with Thai domestic banks, the Philippine banks were far behind in their the capital-labor ratio as well as in their labor productivity.

For the differences, while the business operations of Thai domestic banks diversified in the 1990s, the operational income of Philippine domestic banks became more heavily dependent on the traditional loan business. Although domestic banks in the Philippines earn a higher proportion of non-interest income compared with Thai banks, the share of non-interest income in their total operational income tended to decline in the mid 1990s. The second difference is that the profit ratio in terms of ROA rose in Thailand, it fell in the Philippines.

The first observation suggests that as Philippine macroeconomic conditions improved in the 1990s, the Philippine domestic banks expanded the volume of their loan business. The second observation suggests that the total assets of the Philippine domestic banks expanded more rapidly than their operating income. This reflects the intensive effort of domestic banks to enhance their capitalization in response to the intensifying prudential regulations imposed in the 1990s.

B. Comparison of Cost Functions

Table 10 shows that both the Philippine and Thai domestic banks experienced the "economies of scale" and technical progress. In this sense, the Philippine domestic banks share basic similarities with Thai domestic banks. However, interestingly, the type of technical progress of domestic banks observed in the Philippines differs from that in Thailand.

In Thailand, the technical progress in domestic banks was of a labor-saving type. Intensifying market competition in both countries in the 1990s prompted the domestic banks to make investments in modernization and branch networks, which raised the labor productivity. The labor-saving technical progress seems to relate to this. However, different from Thailand, while the technical progress among the

Philippine banks was of a labor-saving type until 1991, it changed to be of fund-saving type after 1992.

It seems that this difference comes from the financial regulations in the Philippines. In the Philippines, the capital adequacy ratio was higher than in Thailand during the period from the late 1980s until the mid 1990s. In order to keep the high capital adequacy ratio, the Philippine domestic banks responded to the intensifying market competition by suppressing their loan assets expansion as much as possible. This business behavior helps improve the rate of return on banks' raised funds, which results in technological progress of the fund-saving type.

6. Conclusions

As the Philippines enter into the 1990s, and as its macroeconomic environment has achieved a certain degree of stability, a series of financial reform measures were once again undertaken. The primary thrust of these reforms is competition-promoting policy. In response to this change in the environment, domestic banks in the Philippines are making vigorous investments, trying to modernize and expand their branch networks.

A changing picture of the banks' business operations can be observed from the financial data in Section 2. First, as production gets more capital intensive, capital-labor ratio will consistently decline. Second, labor productivity will rise parallel to this development. And third, the relative price of labor in the factor market will experience an increase.

Banking is said to involve "economies of scale" and "economy of scope" as its characteristics. Setting the objective on realizing these economies, in the early 1980s the Philippines took the lead in introducing universal banking among the ASEAN countries. The results of econometric estimation in Section 3 and 4 indicate the existence of "economies of scale" for large and medium-sized banks.

While it has often been cited that the banking industry in the Philippines has an oligopolistic market structure and cost-minimization is not fully realized, the findings fulfill the expected characteristic of such a market in this respect. The results of econometric estimation in Section 3 and 4 indicate an existence of "economies of

scale" for large and medium-sized banks. Similar to banking industries of developed countries, the Philippine banking industry fulfills expected characteristic of banks' production technology.

As for "economies of scope," econometric analysis in this paper identified it only partially. Although domestic banks in the Philippines earn a higher proportion of non-interest income compared with prevailing levels in other countries of the same region, our findings in Section 3 suggest that business diversification is scarcely related to saving the cost of business operation. As the Philippine macroeconomic condition improved in recent years, we have seen a recovery in the volume of bank loans. We may thus conclude that domestic banks are facing the testing ground for more genuine diversification that will enable them to take advantage of "economies of scope."

Section 4 concludes that technical progress among the Philippine banks is of a labor-saving type. As stated earlier, intensifying market competition has prompted domestic banks to actively make new investments. The findings in Section 4 seem to correspond with this fact. However, its statistical significance is not strong enough and its bias is not as clear. While banks' technical progress observed here seemed to be of the labor-saving type until the beginning of the 1990s, technical progress became less labor-saving in the mid 1990s. Even though Philippine banks have expanded modernization investments in the 1990s, their performance falls short of expectations. If efficiency can be achieved from these investments, it will reduce the intermediation cost of the banking industry in the future.

Recent intensifying market competition gives the Philippine domestic banks strong incentive to suppress their loan assets expansion to keep the capital adequacy ratio high. Such efforts include the enlargement of the off-balance sheet transaction and capitalization of loan assets. These business behaviors help improve the rate of return on banks' raised funds, which results in technological progress of the fund-saving type. The fund-saving type technological progress is an interesting characteristic featured in the Philippine domestic banks' operational behavior of the 1990s.

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Appendix B

Following Okuda and Mieno (1997), the Hessian matrix in (4d) can be rewritten as follows:

$$Hp\left[\frac{\partial^2 C}{\partial P_l \partial P_m}\right]=\begin{bmatrix} \gamma_{11}+\beta_1(\beta_1-1) & \gamma_{12}+\beta_1\beta_2 & \gamma_{13}+\beta_1\beta_3 \\ \gamma_{21}+\beta_2\beta_1 & \gamma_{22}+\beta_2(\beta_2-1) & \gamma_{13}+\beta_1\beta \\ \gamma_{31}+\beta_3\beta_1 & \gamma_{32}+\beta_3\beta_2 & \gamma_{33}+\beta_1(\beta_1-1) \end{bmatrix}$$

$$=\begin{bmatrix} 1 & 0 & 0 \\ \lambda_{21} & 1 & 0 \\ \lambda_{31}\lambda_{32} & 1 & \end{bmatrix}\begin{bmatrix} D_1 & 0 & 0 \\ 0 & D_2 & 0 \\ 0 & 0 & D_3 \end{bmatrix}\begin{bmatrix} 1 & \lambda_{21}\lambda_{31} & \\ 0 & 1 & \lambda_{21} \\ 0 & 0 & 1 \end{bmatrix} \qquad (l,m=1,2,3)$$

It is known that the Hessian matrix is negative semidefinite, if and only if its Cholesky values D_q $(q=1,2,3)$ are non positive. Therefore, since $\sum \gamma_{hi}=0$ $(h,i=1,2,3)$ for D_q $(q=1,2,3)\leq 0$, a sufficient condition of (4d) is given by $\gamma_{hi}=0$ $(h,i=1,2,3)$. Substituting (4a), (4c), (5), and $\gamma_{hi}=0$ $(h,i=1,2,3,h\neq i)$ into cost function (3) gives us the estimate equation (6).

Appendix A

Data Availability of Individual Banks

Name of Bank	96	95	94	93	92	91	90	89	88
Large Banks									
Metropolitan Bank									
Bank of the Philippine Islands									
Philippine Commercial Int. Bank									
Far East Bank and Trust Company									
Rizal Commercial Banking Corp.									
United Coconut Planters Bank									
Allied Banking Corp.								*n.a.*	*n.a.*
Equitable Banking Corp.									
China Banking Corp.									
Medium Banks									
Union Bank of the Philippines								*n.a.*	*n.a.*
Citytrust Banking Corp.									
Solidbank Corp.									
Security Bank									
Prudential Bank									
Banco De Oro Commercial Bank		*n.a.*			*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
Philippine Bank of Communications									
Asian bank Corp.		*n.a.*							*n.a.*
Small Banks									
Philtrust Bank					*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
International Corporate Bank		*n.a.*	*n.a.*	*n.a.*					
Traders Royal Bank	*n.a.*								
Pilipinas Bank								*n.a.*	*n.a.*
Philippine Banking Corp.						*n.a.*	*n.a.*	*n.a.*	*n.a.*
Urban Bank Inc.						*n.a.*	*n.a.*	*n.a.*	*n.a.*
Bank of Commerce						*n.a.*	*n.a.*	*n.a.*	*n.a.*
Philippine Veterans Bank					*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
East West Banking Corp.				*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*